Leak Detection
Bulletin

Proactive Aboveground Storage Tank Management Strategies

June 2002

Aboveground storage tanks have been in use, virtually since the beginning of oil production. However, limited information is available on an integrity verification method referred to as a Mass Leak Detection testing. Tanks vary considerably in size, from small where the size is typically a few hundred barrels to extremely large tanks at thousands of barrels. Additionally the generally high reliability of these tanks has meant that tank maintenance approaches have tended to be reactive rather than proactive. Whatever the case, review of tank design and operating experience shows that tank issues can be complex and responses to leaks have been costly and anything but simple.

The failure of a tank can have several undesirable effects such as endangering personnel, affecting the environment and interrupting the operator's business. In a 1988 API worldwide survey, tank ruptures accounted for 5 % of the 132 releases that occurred worldwide between 1970 and 1988 but accounted for almost 19 % of the released material. The cost of clean up, damage to the environment and adverse publicity created present tank regulations and the development of API 653.

It is apparent that a proactive plan, rather than reactive measures, should be taken in tank maintenance to confirm integrity. It is interesting to note that in the USA, tank regulations and rules generally focus on migration rather than preventive aspects; for example leaks and spills are mitigated by secondary containment rather than prevented by design, inspection, and integrity leak detection testing. The importance of inspections, leak detection and monitoring in avoiding failures, maintaining safety and optimizing availability is unquestionable. However, in a competitive business environment, down time for inspections must be justified.

Consideration of the cost of litigation, unfavourable publicity through media and fines from accidental releases alone may warrant a tank testing and inspection program. Companies therefore require a consistent approach for assessing tank integrity and maintaining compliance with industry standards and regulations. Such an approach should

- Confirm tank integrity
- Reduce the potential for significant releases in the near future
- Maintain tanks in safe operating condition, and
- Make repairs and determine if and when replacement is necessary.

API 653 is an important document that addresses suitability for service, repair and alteration requirements for large aboveground steel storage tanks. API 653 cannot provide all answers to all issues and therefore should be regarded as outlining a program of minimum requirements for maintaining tank integrity. It's a guideline to ensure that large leaks, or catastrophic failure do not occur.

Confirming that a tank will not leak goes beyond ensuring that it will not fail catastrophically, since even a small leak is unacceptable. If using the API 653 shell-thickness calculations, minimal data may assure extensive repairs are not required, then extensive additional expenses for further analysis may not be justified and a leak test may satisfy regulatory standards. However, if the initial inspection and evaluation results show that there is a significant problem, then an additional inspection and evaluation is well worthwhile. This reinforces the benefits of maintaining proper leak testing results, tank design, fabrication, and inspection records.

Tank Inspection and Leak Methods

Appendix C of API 653 contains comprehensive checklists to perform in-service and out-of-service visual inspections. The philosophy of API 653 is to gather data and to perform a thorough initial inspection in order to establish a baseline for each tank inspection. The scope of inspection is always subject to interpretation: for instance, a limited inspection may miss the one pit in the floor that can lead to a leak. To inspect for floor topside corrosion, it is essential that the floor be cleaned. While expensive (several tens of thousands of dollars for a crude tank), its one way of uncovering defects. It is usually found that tank integrity costs are dominated by cleaning / sludge removal prior to the inspection, and the confined space entry precautions, rather than by the actual inspection costs.

Few alternatives are available to inspect the tank bottom for underside corrosion. Commercially available inspection techniques include those based on magnetic-flux exclusion and automated ultrasonics. Both inspection techniques require that the floor is dry and free of dirt, sediment and corrosion products. If the tank interior is accessible for visual examination, a minimum number of measurements should establish nominal thickness and additional inspection of the corroded areas would provide corrosion rate data.

The issue of hydrotesting is also of interest. In view of the fact that testing can only be performed under a head of water equal to the tank height, and only gives 125% stress for a tank designed. While the benefits of overstress under controlled conditions are beneficial, it is only a stress test and is not a leak test

An alternative technology is available to provide on line inspection with any fluid in large aboveground storage tanks or can be used in conjunction with hydrotesting. Mass Technology Corporation (MTC) from Kilgore Texas developed the mass measurement technology and testing services are provided by Cantest Solutions in Canada. This technique involves lowering a bubbler unit to the tank bottom. A differential reference tube is placed just above the liquid surface. Nitrogen gas is conveyed to the bubbler unit at a precisely controlled rate, and an additional tube is attached that eliminates the friction and subsequent backpressure affects on the differential pressure transducer. The pressure required to generate a stream of bubbles at tank bottom corresponds to the differential pressure as a result of the

fluid mass. The pressure is measured by a micro-sensitive differential pressure transducer, which is recorded on a real-time basis and post processed. Data analysis routines accurately calculate any changes in the mass of fluid within the tank and determine if there is a loss. Mass measurement system, can be used with all types and sizes of tanks and viscous products, is safer, more economical and more precise than conventional testing methods. The MTC leak detection tests is field-proven and third party performance evaluated and certified. This advanced technology will detect leaks at a threshold of less than 0.80 gallons per hour in a 100,000-barrel tank.

All this assumes that any leak is from in-service deterioration, but there is significant evidence of leaks from new construction, through weld defects or even missing welds. Vacuum testing of floor welds is a physically demanding task and depends a great deal on operator diligence for success and can miss locations where there are physical limitations or impediments. It has been known for tanks to be put in service with large sections of the inside floor to shell weld missing. MTC mass testing in conjunction with the hydrostatic test would eliminate this concern.

Table 1. Testing methods for aboveground storage tanks

Test	Leaks that could be missed by test
Vacuum box	Human error leak in area not tested could miss any size leak
Ultrasonic thickness	Large areas of tank not inspected –any size leak could be missed
Magnetic flux scan	Area not scanned could leak–large leak could be missed
Hydrotest with dye	Tanks have been tested with 200 gph leak not evident outside
Mass measurement	Leaks less than 0.5 gph could be missed–all others detected.

Conclusions

Tanks can pose hazards to the community, the environment and to operating companies because of the large inventory of materials. Risk based and risk directed MTC mass integrity testing, offers potential for establishing an adequate, cost effective program, when developing tank integrity management programs.

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